TOOLKIT AND MINDSET: DESIGN GUIDANCE FOR ROAD DRAINAGE IN AUCKLAND TRANSPORT

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ABSTRACT

Auckland Transport Code of Practice (ATCOP) aims to align design process with issues and outcomes for SW management in Auckland. The Plans, Codes and Guidelines proposed for Auckland are described.

A new approach to defining design objectives is set out –

Quality management design: deals with frequent rainfall for contaminants, volume reduction, and attenuation.

Serviceability management design: Rainfall run-off managed within the road reserve for acceptable levels of service for road users, limiting hazards and nuisance.

Major event management design: Effects of infrequent severe conditions managed to ensure survivability or recovery of infrastructure, accessibility for emergency services and protection of personal safety and property.

ATCOP will require designers to address all these objectives in road drainage designs. This should set designers to think of LID, of surface water shedding and collection, and of effects of flooding when preparing designs.

Road engineers need little new guidance on conventional catchpit and pipe design. ATCOP focuses on LID, to ensure that roads are planned for natural process drainage as far as possible.

Operation and maintenance plans are required. These will allow operational issues to be described, and whole life costs to be evaluated when choosing between alternative solutions.

KEYWORDS

Design guidelines, low impact design, value for money

PRESENTER PROFILE

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Specialist for Auckland Transport, leading collaboration with Auckland Council on stormwater across the Auckland Region. The newly-formed Project Specialist Team is strengthening the integration of developing best practice in urban design, sustainable transport and environmental sustainability in Auckland Transport.

1 INTRODUCTION

Auckland Council (AC) and Auckland Transport (AT) faced two major tasks on their creation: the harmonization of legacy Plans and Codes from the Regional and District Councils, with their variation arising from different contexts, different responsibilities and different policy directions; and the preparation of new Plans and Guidelines to plan for and manage the future growth of Auckland.

This paper gives the context of the new Plans and Guidelines that assemble the toolkit to support these two tasks, focusing on the place of the Auckland Transport Code of Practice (ATCOP) and its linked documents. The toolkit for Road Drainage is described, in its first edition form and in preparation for future revisions.

Legacy Codes of Practice have dealt with the tools for design. However, the challenge facing Auckland is one of transformation as well as continuation, and ATCOP seeks to help development of the right mindset amongst planners, developers and engineers responsible for creating the future city.

The first edition of ATCOP seeks to structure design guidance to promote a mindset that will encourage and nurture good urban design, including road drainage. To achieve this, the nature and order of its content focuses less on traditional design requirements, which are generally well covered by other publications, than on matters that are less well understood relating drainage to urban design principles for Auckland that lead to fresher approaches to drainage management.

2 DESIGN GUIDANCE FOR ROAD DRAINAGE

2.1 ATCOP AND ITS RELATION TO AUCKLAND PLANS

2.1.1 THE PLAN FRAMEWORK

The Auckland Plan was adopted by Auckland Council in March 2012. The Auckland Plan sets a strategic direction for Auckland and its communities that integrate social, economic, environmental and cultural objectives. It estimates that Auckland's population could grow from 1.5 million to 2.5 million by 2040 (under a high-growth projection scenario). Together, the Auckland Plan and the Unitary Plan provide the overall vision and direction that guide the future development of the whole Auckland region.

The Draft Unitary Plan brings together the direction on regional and district planning that was previously covered by Regional and District Plans. It provides the controls through the RMA to enable the transformation of Auckland to give effect to the Auckland Plan.

Auckland Transport has developed an Integrated Transport Programme (ITP) which sets out a transport programme for the 30 year period to 2041 that integrates the major projects prioritised in the Auckland plan with a supporting programme of investment in transport infrastructure and services.

The ITP provides an integrated view of the transport investment programme across the transport system, including state highways and local roads, railways, buses, ferries, footpaths, cycleways, intermodal transport facilities and supporting facilities such as parking and park-and-ride.

The ITP has been produced by Auckland Transport and the New Zealand Transport Agency with input and support from Auckland Council. It responds to the strategic vision, outcomes and targets of the Auckland Plan and to the government's wider transport policies.

The purpose of the ITP is to coordinate the investment and other activities of Auckland's transport network providers to ensure these contribute effectively and efficiently to meeting the growth and development needs of Auckland and its adjacent regions over the next 30 years.

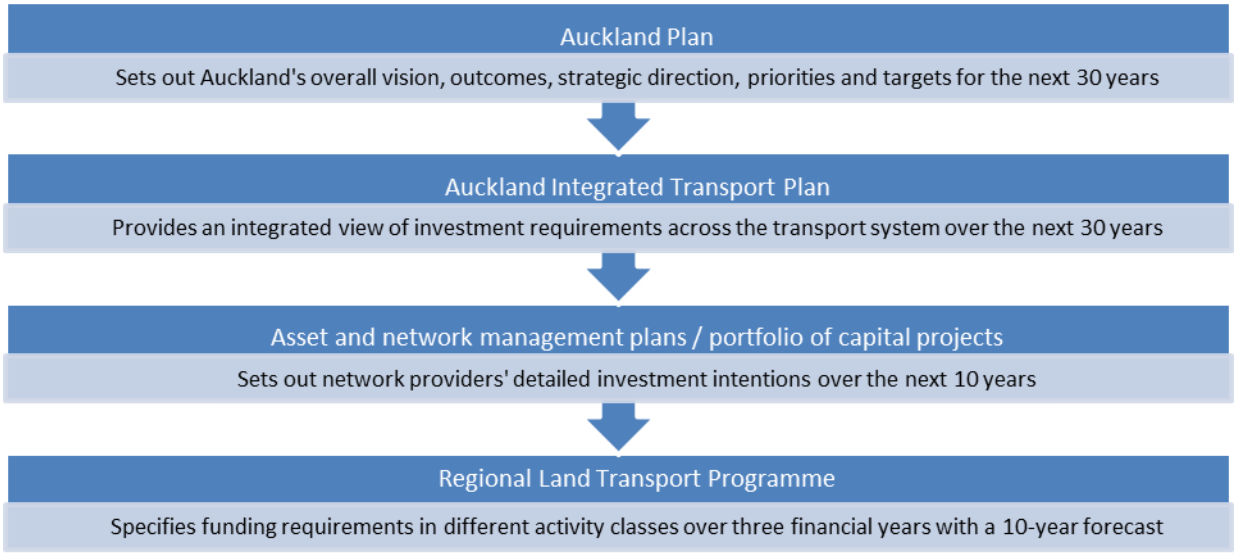

Figure 1: Transport Plans and Programmes

2.1.2 ATCOP AND SISTER CODES

ATCOP sits under these documents to provide clear guidelines that will facilitate good design of the transport system in delivering on the Auckland Plan.

AT has also produced a series of Governing Principles under its Asset Management Plan. These set out approaches to various asset types. The Stormwater Governing Principle is one of these. They are referenced within ATCOP.

ATCOP also operates alongside Auckland Council's guidelines. These are to be incorporated into the Auckland Design Manual, which is an online guide for everybody involved in developing Auckland's built environment. The manual is the complementary document to the Unitary Plan and will provide supporting design guidance, case studies and worked examples. Associated with this are AC Stormwater Code of Practice (SWCOP) and Watercare Services Water and Wastewater Code of Practice for Land Development and Subdivision (WWCOP).

Legacy Auckland Regional Council Technical Publications (notably TP 108, TP 10, TP 124) remain in place until AC's new Guideline Documents (GD series) progressively replace them.

2.1.3 STYLE AND CONTENT OF ATCOP

ATCOP provides guidance on planning and designing new roads and redeveloping existing roads. It makes use of Austroads Guidelines, but focuses on applying good design in the context of Auckland to accomplish the Auckland Plan.

There is a strong emphasis on integrated planning and design, and how the design process should be carried through.

Within this, stormwater management receives attention with regard to environmental management and sustainability, urban design and asset management. A chapter on Road Reserve Drainage deals specifically with design for drainage.

2.2 ATCOP: ROAD RESERVE DRAINAGE

2.2.1 CONTENT OF CHAPTER

This chapter commences with a reference to the Stormwater Governing Principle which states the approach to be taken in designing new or managing existing road drainage assets.

In the same way as NZS 4404:2010 and legacy codes require road drainage to comply with Stormwater code requirements, this chapter of ATCOP requires stormwater design to comply with AC SWCOP and WWCOP (for connections in Combined Sewer Catchments).

Design is also required to follow the principles and methods of 'Guide to Road Design – Part 5: Road Drainage' (Austroads, 2013) which, in its latest update, provides a comprehensive reference work on drainage for Australasia.

However, the main content of the chapter deals with approaches to apply design best practice to the Auckland context, and then to give specific requirements for particular elements for public road asset standards.

Leading the guidance are sections dealing with different emphases that aim to focus planning and design on key factors, not only for engineers, but also for developers and planners, so that they are encouraged to incorporate drainage planning into their projects appropriately.

Firstly, Integration of Drainage is set out, with reference to Catchment Management Plans and Network Discharge Consents. Road drainage is to be considered in conjunction with neighbouring land use.

Low Impact Design is required, as an approach to planning even if conventional stormwater management systems may be the appropriate outcome of this process.

Other sections deal with Surface Water Management, Low Impact Design – Preferred Systems, Proprietary Devices, Kerbs and Channels, Catchpits, Subsurface drains and Side drains. However, one section may be of interest in terms of encouraging a creative mindset for drainage planning.

2.2.2 TIERED OBJECTIVES FOR SW MANAGEMENT DESIGN IN ROAD RESERVES

This section of ATCOP sets out three objectives for design: -

Quality management design. Designed typically for rainfall up to Water Quality Volume (half the 24 hr run-off from 50% AEP design storm). Rainfall from most

of any year should be managed through LID to reflect natural processes for quality treatment, volume reduction, groundwater recharge, attenuation and dispersed discharge.

Serviceability management design. Designed typically for rainfall up to 10% AEP design storm. Rainfall run-off should be managed within the road reserve to maintain acceptable levels of service for road users, limiting hazards and nuisance.

Major event management design. Designed typically for storms up to 1% AEP, to ensure survivability or recovery of infrastructure, accessibility for emergency services and protection of personal safety and habitable or commercial property. Also consider any significant consequences of run-off exceeding the design peak flow; greater protection for identified critical infrastructure (0.5% or 0.2% AEP); and effects of coastal inundation from tides, sea-level rise or tsunami.

2.2.3 QUALITY MANAGEMENT DESIGN

Conventional road drainage design focuses on capture and conveyance of 10% AEP run-off. For 360 days of the year, this is not what happens. So, although conventional catchpits and pipes deal with all run-off up to that 10% storm, they are not designed to be the best way of treating everyday conditions.

A focus on natural drainage systems is more aligned with sustainable environmental management, allowing integrated design to return rainfall to a more natural hydrology.

Natural systems can work well with design for place, introducing soft landscaping to road reserve and open space, and encouraging a strong relationship of road layout to natural landform and watercourses.

Putting this in first place aims to highlight the importance of people's everyday experience of the public realm, particularly for those travelling by active modes or lingering within public space for working, living or recreation.

2.2.4 SERVICEABILITY MANAGEMENT DESIGN

This is the typical conventional design focus, and is often expressed as the capacity of a primary drainage system. It is also described as Minor drainage (Austroads, 2013). It is based on the maximum rainfall that should be accommodated within the road without unacceptably affecting road use. For vehicular traffic, this is generally base on 10% AEP run-off, and ensuring depth at kerbline, velocity and width of channel flow that are safe for traffic. Different road categories will require different levels of service, and Austroads (2013) aids this design.

For pedestrians and cyclists, different standards may apply, relating to the rainfall conditions that are appropriate for users to expect to travel on footpaths or in cycle lanes without a significant depth or flow of surface water. Design parameters may be project specific. For example, a busy transport plaza may require relatively dry passage for passenger transfer in heavy rainfall, whereas in a quieter area, path users may be expected to take shelter away from rain. For short cycle trips, it may be reasonable to expect cyclists to take shelter, whereas a long commuter route may not offer refuge and safe cycling needs to be maintained through heavy rain.

It also addresses hazards. This particularly relates to surface water safety issues. GRD 5 provides an approach to aquaplaning evaluation, which is particularly necessary for wide, flat areas encountered at some major intersections, and transition areas at curves.

Nuisance addresses problems of concentrated flow which may not be strictly hazardous, but which should not inconvenience road users. For example, significant channel flow at pedestrian crossings would be a nuisance that should be avoided. At cycle path ramps, this can be a hazard.

Based on Austroads (2013), ATCOP will provide a clearer statement of the design criteria for different road and user requirements, to ensure that serviceability design is appropriate for context.

2.2.5 MAJOR EVENT MANAGEMENT DESIGN

Code requirements tend to be expressed placing primary systems first, and secondary systems are discussed at the end of a section. ATCOP aims to elevate consideration of major events, following the pattern set in Austroads (2013). Integrated design and LID planning should encourage designers to plan development for overall catchment behavior. Road design should therefore be approached to deal with major event run-off, and then to provide a primary drainage system to achieve serviceability and quality objectives, rather than merely to evaluate effects of secondary flow.

Plan rules aim to protect habitable floors, and this often drives secondary flow evaluation in road project design. It is necessary to require more than that, to protect the infrastructure and redevelopment potential of a growing city.

The statement of an objective covering climate change and protection of critical infrastructure allows designs to be prepared and reviewed for this objective.

Valuable guidance on design for major events is provided in Austroads (2013). This objective in ATCOP will require use of Austroads (2013) for design, and is more fully developed in a section on the Major/minor drainage concept in ATCOP.

2.2.6 INFRASTRUCTURE FOR TIERED OBJECTIVES

A prime focus on water quality design is intended to lead to appropriate infrastructure. This may be planned as either integrated provision, including treatment of adjoining land or as treatment for road run-off alone. GD and other guidance will allow their design, including evaluation processes for proprietary solutions.

Often, natural systems will be able to contribute significantly to this objective, and vegetation and soft landscaping will count towards this. It will be appropriate to contribute to Auckland Plan objectives through drainage infrastructure, and a tree may do more towards this than a catchpit.

Design at this level can make use of infrastructure that has capacity to accept 95 %ile rainfall. It has the potential to achieve this with very little run-off beyond the site, or beyond off-site treatment (such as raingarden or wetland), and contribute to a hydrology that supports more desirable base flows and natural peaks in streams. This can be significant for many arterial ridge roads, which have large impervious areas running towards the headwaters of stream catchments.

Infrastructure for serviceability should be supplementary to quality management infrastructure. Typically, it would provide by-pass or overflow capture and conveyance

for on-site treatment systems. Initial capture and conveyance is needed for off-site or large treatment systems such as wetlands or large raingardens.

In cases where quality treatment is not required to be provided, conventional catchpit and pipe may be most economical, but should not always be first choice.

The range of options for capture and conveyance is being extended, and selection based on inlet capacity, with regard to whole life costs including operational has some consequences. Stormwater manholes may be spaced further apart, and many roads have limited access to reticulation, so simply providing standard catchpits at nominal spacing does not guarantee acceptable service. Selection of the appropriate system needs to take account of detailed serviceability design as well as economy of options.

Infrastructure considerations for major events includes road cross section profile, consideration of intersections and vehicle crossings and land form effects on spill points.

It also requires consideration of life-line requirements for access. Crossing watercourses may lead to particular problems. Many existing culverts have been built for upstream land uses that have changed, and have capacity based on different run-off expectations from current standards. In some cases, flood protection management may lead to Council projects to increase culvert capacity. If this is not seen as necessary for upstream land development, then culverts may remain in use with less than desirable capacity. The effects of this need to be considered, and it may be necessary to provide mitigation. Overtopping of a road on embankment can threaten the structure of the road itself, or critical infrastructure passing through the road corridor, or critical infrastructure beyond the road. Risks need to be assessed, and measures evaluated for incorporation in road improvement projects.

2.3 MINDSET FOR ROAD DRAINAGE DESIGN

2.3.1 STORMWATER PLANNING AND DESIGN CONTEXT

The stormwater community is accustomed to thinking in terms of quality treatment, and the range of planning and design tools and solutions for natural hydrology. Water NZ provides a significant forum in New Zealand for developing this community and the mindset for addressing the significant issues for stormwater management.

Change in understanding of the issues and how to deal with them continues. Research, development and practical application of methods has progressed.

However, much of the planning and management of stormwater is focused on Regional Plan rules, and stormwater discharge consents are often divorced from transport planning and design. This can isolate the stormwater community from integration in the planning and design of road projects.

It is not good to separate consideration of stormwater management from the overall planning of transport management. Often, network discharge consents and catchment management plans may tie down particular design solutions before road design has progressed to optimize options. Road drainage design can become a mechanical process, applying standardized solutions that are not necessarily going to be the most effective environmentally or economically.

2.3.2 INTEGRATED DRAINAGE AND TRANSPORT PLANNING AND DESIGN

ATCOP aims to provide design and review tools that encourage and support a mindset that will elevate and integrate stormwater planning with transport planning and design.

Where LID planning has been employed, or where Catchment Management Planning has identified BPO objectives for the transport system, it is necessary to provide the right tools for giving effect to planned outcomes. ATCOP calls for Low Impact Design to be applied in all cases, even where this leads to a design decision for conventional drainage features. This is intended to promote low impact thinking in all road planning and design.

By stating these design objectives in ATCOP, AT aims to focus transport planners and road designers on the need to consider them at the earliest point, and to develop solutions that keep them in mind.

If this is done, then it is less likely that road development will store up future environmental deficits, and will support rather than stifle development that does not harm the environment.

It should not be more difficult to design and gain approval of stormwater management solutions that support CMP objectives than systems that do little for catchment issues. ATCOP aims to be permissive of best practice design, and not to hamper the development of new best practices.

In particular, the Tiered Objectives for SW Management Design aim to promote thinking in terms of everyday, occasional and extreme rainfall. Each of these has different objectives and so requires a different approach to design, which then combines to a single set of infrastructure. Because the run-off in each case is quite different, it does allow for very different management techniques. Separating objectives for quality from objectives for serviceability should promote consideration of the value of vegetation and other natural drainage features, even where economical use of these may not fully meet treatment or capacity requirements by themselves.

Early consideration of whole life costs should also be encouraged. ATCOP is intended to facilitate planning based on developing cost/benefit evaluation of stormwater management systems. It is not good practice to proliferate systems that have high consequential operational costs.

It is easy to make policy decisions to protect the environment, and require capital investment to be funded out of development to do so. It is also easy to make policy decisions to reduce operational expenditure by requiring savings in maintenance. Where savings can be achieved by efficiency without reducing level of service, this is good. However, there can be pressure to reduce levels of service where still greater savings are sought.

The ability to maintain and operate stormwater systems to achieve their environmental design outcomes is under threat from this. It is necessary to ensure that new systems are able to demonstrate value for money, so that operational funding is not drawn away from them. It is also necessary to ensure that, even with good environmental value, the cost does not reduce a community's ability to fund its other services necessary to a sustainable city.

ATCOP aims to promote value-for-money design, and to promote solutions with operational costs that will complement a sustainable city. Creative designs, planned with these objectives in mind, will be encouraged.

The Stormwater Governing Principle is controlled under the Asset Management Plan and provides direction within AT for new works and for renewals and maintenance. This will ensure that a consistent approach is taken in managing the transport system as a whole

to progressively improve the effectiveness of public road assets in affordably managing stormwater.

2.3.3 FUTURE DEVELOPMENT OF TOOLKIT

The first edition of ATCOP is forming a bridge from legacy guidelines to the possibilities of future guidance. As other codes and plans become operational, it will be amended to refer to them and make use of them. Auckland Council's GD series will be significant in respect of road drainage. The Auckland Unitary Plan will also be vital, and ATCOP will respond to the Inquiry process that will make that operative.

Various other lines of work will be needed to fill in the toolkit. For example, design charts for inlet capacities for the full range of capture systems that are approved for use are needed. This aids not only design but also review and approval, which can reduce time and cost for development.

Whole life cost guidance can be used to simplify option selection and allow robust review and approval. This can work together with Operation and Maintenance Manuals to aid asset planning and funding of maintenance contracts.

Development of the Auckland Design Manual will also link to ATCOP, and provide guidance on how road drainage will fit into urban design. This will affect integrated drainage design, low impact design and the functions of soft landscaping in streetscape.

3 CONCLUSIONS

As Auckland develops its full range of Plans, Codes and Guidelines to equip the community with the tools to grow the city, it is vital that each part of the toolkit should encourage the change in mindset that will tend to achieving the city that we want and need. Road Drainage guidance in ATCOP has been prepared to support this approach.

Many tools are already available to aid design, but Codes need to give direction to the use of these tools. ATCOP Road Drainage has focused on the objectives for road drainage design. A section on Tiered Objectives provides an introduction to thinking of drainage design in ways that promote low impact design and economical ways of achieving desirable service levels, safety and security across Auckland's transport system.

The mindset of clients, planners and designers is of great importance, and ATCOP aims to make clear the elements of good design. It aims to make a place for drainage planning and design within overall urban design, and to promote sustainable low impact planning.

Consistent application of these principles should move the management of stormwater in public road reserve towards the objectives set for it in the Auckland Plan.

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Austroads (2013) 'Guide to Road Design – Part 5: Road Drainage' In draft at time of writing, Austroads Online Publications